

**Claims:**

1. A method of suspending a well comprising the steps of:  
providing a first barrier in the well;  
5 verifying the integrity of the first barrier;  
thereafter providing at least a second barrier in the  
well above the first barrier defining a space between the  
first and second barriers; and,  
verifying the integrity of the second barrier, the  
10 method characterised in that the first and second barriers  
are below the depth of a lowermost end of a completion  
string when the completion string is installed in the well  
and remain in position while the well is suspended.
- 15 2. A method of suspending a well according to claim 1  
wherein the step of verifying the integrity of the second  
barrier further comprises the step of measuring the  
pressure in the space between the first and second  
barriers.
- 20 3. A method of suspending a well according to claim 1  
wherein the first and/or second barrier(s) is/are selected  
from the group consisting of: a cement plug; an  
unperforated liner; a section of unperforated casing; a  
25 liner top valve; a bridge plug; a straddle; an expandable  
plug; a disappearing plug; a rupture disc; or an inflatable  
plug packer.
4. A method of suspending a well according to claim 1  
30 wherein the first and/or second barrier(s) comprise(s) a  
combination of a physical device, a means for securing the  
position of the physical device, and a sealing means.
5. A method of suspending a well according to claim 4  
35 wherein the sealing means is selected from the group  
consisting of: a ball valve; a flapper valve; a sliding

sleeve; a pressure cycle plug; a wireline retrievable plug;  
a rupture disc; a formation isolation device; a shear disc;  
and/or a pump open device.

5    6.    A method of suspending a well according to claim 4  
      wherein the sealing means is positioned distally from the  
      physical device.

      7.    A method of suspending a well according to claim 1,  
10    further comprising the step of installing a first and/or  
      second liner hanger in the well.

      8.    A method of suspending a well according to claim 7  
      wherein the first and/or second barrier are provided within  
15    the first and/or second liner hanger.

      9.    A method of suspending a well according to claim 1  
      further comprising the step of installing a first and/or  
      second liner in the well.

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      10.   A method of suspending a well according to claim 9  
      wherein the first and/or second barrier are provided within  
      the first and/or second liner.

25    11.    A method of suspending a well according to claim 1  
      wherein the well includes at least one casing string and  
      the first and/or second barriers are provided within the at  
      least one casing string.

30    12.    A method of completing a well, comprising the steps  
      of:

          providing a first barrier in the well;

          verifying the integrity of the first barrier;

          thereafter providing at least a second barrier in the

35    well above the first barrier defining a space between the  
      first and second barriers;

verifying the integrity of the second barrier;

relying on the first and second barriers to provide well control during installation of a completion string in the well, the completion string having a lowermost end;

5 and,

installing a production flow control device on the well for regulating the flow of fluids through the well, the method characterised in that the first and second barriers are below the depth of the lowermost end of the completion string when the completion string is installed in the well.

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13. A method of completing a well according to claim 12 wherein the step of verifying the integrity of the second barrier further comprises the step of measuring the pressure in the space between the first and second barriers.

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14. A method of completing a well according to claim 12 wherein the first and/or second barrier(s) is/are selected from the group consisting of: a cement plug; an unperforated liner; a section of unperforated casing; a liner top valve; a bridge plug; a straddle; an expandable plug; a disappearing plug; a rupture disc; or an inflatable plug packer.

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15. A method of completing a well according to claim 12 wherein the first and/or second barrier(s) comprise(s) a combination of a physical device, a means for securing the position of the physical device, and a sealing means.

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16. A method of completing a well according to claim 12 wherein the sealing means is selected from the group consisting of: a ball valve; a flapper valve; a sliding sleeve; a pressure cycle plug; a wireline retrievable plug; a rupture disc; a formation isolation device; a shear disc;

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and/or a pump open device.

17. A method of completing a well according to claim 15  
wherein the sealing means is positioned distally from the  
5 physical device.

18. A method of completing a well according to claim 12,  
further comprising the step of installing a first and/or  
second liner hanger in the well.  
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19. A method of completing a well according to claim 18  
wherein the first and/or second barrier are provided within  
the first and/or second liner hanger.

20. A method of completing a well according to claim 12  
further comprising the step of installing a first and/or  
second liner in the well.  
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21. A method of completing a well according to claim 20  
wherein the first and/or second barrier are provided within  
the first and/or second liner.  
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22. A method of completing a well according to claim 1  
wherein the well includes at least one casing string and  
the first and/or second barriers are provided within the at  
25 least one casing string.

23. A method of completing a well according to claim 12  
wherein the method further comprises the step of installing  
a tubing spool in the well-head prior to the step of  
30 installing the completion string in the well.

24. A method of completing a well according to claim 12  
wherein the production flow control device is a christmas  
35 tree.

25. A method of completing a well according to claim 24 wherein the christmas tree is a horizontal christmas tree.

26. A method of completing a well according to claim 25  
5 wherein the horizontal christmas tree includes having a body, the completion string terminates at its upper end in and is suspended from a tubing hanger, and the method further comprises the step of forming an assembly comprising the horizontal christmas tree and the tubing  
10 hanger by landing and locking the tubing hanger in the body of the horizontal christmas tree prior to the step of installing the production flow control device on the well.

27. A method of completing a well according to claim 26  
15 further comprising the step of installing the assembly on the well in a single operation.

28. A method of completing a well according to claim 24 wherein the christmas tree is a vertical christmas tree.  
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29. A method of working over a completed well, the completed well including a production flow control device and a completion string installed in the well-bore, the completion string having an uppermost end terminating in a  
25 tubing hanger from which the completion string is suspended and a lowermost end, the method comprising the steps of:  
    providing a first barrier in the well;  
    verifying the integrity of the first barrier;  
    thereafter providing at least a second barrier in the  
30 well above the first barrier defining a space between the first and second barriers;  
    verifying the integrity of the second barrier;  
    relying on the first and second barriers to provide well control during removal of the tubing hanger,  
35 completion string, and/or production flow control device from the well; and,

the method characterised in that the first and second barriers are below the depth of the lowermost end of the completion string when the completion string is installed in the well.

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30. A method of working over a completed well according to claim 29 wherein the step of verifying the integrity of the second barrier further comprises the step of measuring the pressure in the space between the first and second barriers.

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31. A method of working over a completed well according to claim 29 wherein the first and/or second barrier(s) is/are selected from the group consisting of: a cement plug; an unperforated liner; a section of unperforated casing; a liner top valve; a bridge plug; a straddle; an expandable plug; a disappearing plug; a rupture disc; or an inflatable plug packer.

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32. A method of working over a completed well according to claim 29 wherein the first and/or second barrier(s) comprise(s) a combination of a physical device, a means for securing the position of the physical device, and a sealing means.

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33. A method of working over a completed well according to claim 32 wherein the sealing means is selected from the group consisting of: a ball valve; a flapper valve; a sliding sleeve; a pressure cycle plug; a wireline retrievable plug; a rupture disc; a formation isolation device; a shear disc; and/or a pump open device.

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34. A method of working over a completed well according to claim 32 wherein the sealing means is positioned distally from the physical device.

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35. A method of working over a completed well according to claim 29, further comprising the step of installing a first and/or second liner hanger in the well.

5 36. A method of working over a completed well according to claim 35 wherein the first and/or second barrier are provided within the first and/or second liner hanger.

37. A method of working over a completed well according to  
10 claim 29 further comprising the step of installing a first and/or second liner in the well.

38. A method of working over a completed well according to  
15 claim 37 wherein the first and/or second barrier are provided within the first and/or second liner.

39. A method of working over a completed well according to claim 29 wherein the well includes at least one casing string and the first and/or second barriers are provided  
20 within the at least one casing string.

40. A method of working over a completed well according to claim 29 wherein the method further comprises the step of installing a tubing spool on the well and thereafter  
25 installing the tubing hanger of the completion string in the tubing spool.

41. A method of working over a completed well according to claim 29 wherein the production flow control device is a  
30 christmas tree.

42. A method of working over a completed well according to claim 41 wherein the christmas tree is a horizontal  
christmas tree.

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43. A method of working over a completed well according to

claim 29 wherein the horizontal christmas tree includes a body and the method further comprises the step of removing the tubing hanger and/or completion string from the body of the horizontal christmas tree by unlocking the tubing hanger from the body of the horizontal christmas tree.

44. A method of working over a completed well according to claim 42 wherein the horizontal christmas tree includes a body and the method further comprises the step of removing the horizontal christmas tree and the completion string as an assembly.

45. A method of working over a completed well according to claim 41 wherein the christmas tree is a vertical christmas tree.

46. A method of working over a completed well according to claim 29 further comprising the step of relying on the first and second barriers to provide well control until the tubing hanger, completion string and/or production flow control device are reinstalled in or on the well.

47. A suspended well comprising:  
a well bore having an uppermost end;  
a well head installed towards the uppermost end of the well-bore; and,  
at least a first and a second independently verified barrier positioned in a spaced-apart relationship in the well bore defining a space therebetween characterised in that the first and second barriers are below the anticipated depth of a lowermost end of a completion string when the completion string is installed in the well.

48. A suspended well according to claim 47 further comprising a pressure measuring means for generating a signal indicative of the pressure in the space between the



first and second barriers.

49. A suspended well according to claim 48 further comprising a signal receiving means for receiving the  
5 signal generated by the pressure measuring means

50. A suspended well according to claim 49 further comprising a means for transmitting the signal from the pressure measuring means to the pressure signal receiving  
10 means.

51. A suspended well according to claim 48 wherein the pressure measuring means is a transducer.

15 52. A suspended well according to claim 47, wherein the well is a sub-sea well, a land well or a platform well.

53. A suspended well according to claim 47 wherein the first and/or second barrier(s) is/are selected from the  
20 group consisting of: a cement plug; an unperforated liner; a section of unperforated casing; a liner top valve; a bridge plug; a straddle; an expandable plug; a disappearing plug; a rupture disc; or an inflatable plug packer.

25 54. A suspended well according to claim 47 wherein the first and/or second barrier(s) comprise(s) a combination of a physical device, a means for securing the position of the physical device, and a sealing means.

30 55. A suspended well according to claim 54 wherein the sealing means is selected from the group consisting of: a ball valve; a flapper valve; a sliding sleeve; a pressure cycle plug; a wireline retrievable plug; a rupture disc; a formation isolation device; a shear disc; and/or a pump  
35 open device.

56. A suspended well according to claim 54 wherein the sealing means is positioned distally from the physical device.

5 57. A suspended well according to claim 47, further comprising a first and/or second liner hanger installed in the well.

58. A suspended well according to claim 57 wherein the  
10 first and/or second barrier are positioned within the first and/or second liner hanger.

59. A suspended well according to claim 47 further comprising a first and/or second liner installed in the  
15 well.

60. A suspended well according to claim 59 wherein the first and/or second barrier are positioned within the first and/or second liner.

20 61. A suspended well according to claim 47 wherein the well includes at least one casing string and the first and/or second barriers are provided within the at least one casing string.

25 62. A completed well comprising:  
a well bore having an uppermost end;  
a well head installed towards the uppermost end of the well-bore;  
30 a production flow control device on or above the well-head;  
a completion string installed in the well-bore and having a lowermost end; and,  
at least a first and a second independently verified  
35 barrier positioned in a spaced-apart relationship in the well bore defining a space between the first and second

barriers, characterised in that the first and second barriers are below the lowermost end of the completion string.

5 63. A completed well according to claim 62 further comprising a pressure measuring means for generating a signal indicative of the pressure in the space between the first and second barriers.

10 64. A completed well according to claim 62 further comprising a signal receiving means for receiving the signal generated by the pressure measuring means.

15 65. A completed well according to claim 62 further comprising a means for transmitting the signal from the pressure measuring means to the pressure signal receiving means.

20 66. A completed well according to claim 63 wherein the pressure measuring means is a transducer.

25 67. A completed well according to claim 63, wherein the production flow control device is a horizontal or vertical christmas tree.

68. A completed well according to claim 62 further comprising a tubing spool installed in the well-head.

30 69. A completed well according to claim 62, wherein the well is a sub-sea well, a land well or a platform well.

70. A completed well according to claim 62 wherein the first and/or second barrier(s) is/are selected from the group consisting of: a cement plug; an unperforated liner; a section of unperforated casing; a liner top valve; a bridge plug; a straddle; an expandable plug; a disappearing

plug; a rupture disc; or an inflatable plug packer.

71. A completed well according to claim 62 wherein the first and/or second barrier(s) comprise(s) a combination of a physical device, a means for securing the position of the physical device, and a sealing means.

72. A completed well according to claim 71 wherein the sealing means is selected from the group consisting of: a ball valve; a flapper valve; a sliding sleeve; a pressure cycle plug; a wireline retrievable plug; a rupture disc; a formation isolation device; a shear disc; and/or a pump open device.

73. A completed well according to claim 71 wherein the sealing means is positioned distally from the physical device.

74. A completed well according to claim 62, further comprising a first and/or second liner hanger installed in the well.

75. A completed well according to claim 74 wherein the first and/or second barrier are positioned within the first and/or second liner hanger.

76. A completed well according to claim 62 further comprising a first and/or second liner installed in the well.

77. A completed well according to claim 76 wherein the first and/or second barrier are positioned within the first and/or second liner.

78. A completed well according to claim 62 wherein the well includes at least one casing string and the first

and/or second barriers are provided within the at least one casing string.

79. A completed well further according to claim 62 further  
5 comprising a tubing spool installed in the well-head.

80. A completed well according to claim 62 wherein the production flow control device is a christmas tree.

10 81. A completed well according to claim 80 wherein the christmas tree is a horizontal christmas tree.

82. A completed well according to claim 80 wherein the christmas tree is a vertical christmas tree.

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83. A dual barrier system for use in suspending, completing or working over a well, the dual barrier system comprising:

20 a first and second body barrier positioned in a spaced-apart relationship in the well and defining a space between the first and second barriers;

a pressure measuring means for generating a signal indicative of the pressure in the space between the first and second barriers;

25 a pressure signal receiving means for receiving the signal generated by the pressure measuring means; and,

a means for transmitting the signal from the pressure measuring means to the pressure signal receiving means.

30 84. A dual barrier assembly according to claim 83, wherein the pressure measuring means is a transducer.

85. A dual barrier assembly according to claim 83 wherein the first and/or second barrier(s) is/are selected from the  
35 group consisting of: a cement plug; an unperforated liner; a section of unperforated casing; a liner top valve; a

bridge plug; a straddle; an expandable plug; a disappearing plug; a rupture disc; or an inflatable plug packer.

5 86. A dual barrier assembly according to claim 83 wherein the first and/or second barrier(s) comprise(s) a combination of a physical device, a means for securing the position of the physical device, and a sealing means.

10 87. A dual barrier assembly according to claim 86 wherein the sealing means is selected from the group consisting of: a ball valve; a flapper valve; a sliding sleeve; a pressure cycle plug; a wireline retrievable plug; a rupture disc; a formation isolation device; a shear disc; and/or a pump open device.

15 88. A dual barrier assembly according to claim 86 wherein the sealing means is positioned distally from the physical device.

20 89. A dual barrier assembly according to claim 83 wherein the well further comprises a first and/or second liner hanger installed in the well and the first and/or second barrier are positioned within the first and/or second liner hanger.

25 90. A dual barrier assembly according to claim 83 wherein the well further comprises a first and/or second liner installed in the well and the first and/or second barrier are positioned within the first and/or second liner.

30 91. A dual barrier assembly according to claim 83 wherein the well further comprises at least one casing string and the first and/or second barriers are provided within the at least one casing string.

35 92. A method of completing a sub-sea well using a

horizontal christmas tree for production flow control, the horizontal christmas tree having a body, the method comprising the steps of:

5 forming an assembly by installing a completion string terminating at its upper end in and suspended from a tubing hanger in the body of the horizontal christmas tree; and, running the assembly to the sub-sea well, the method characterised in that the tubing hanger and the horizontal christmas tree are above the water-line during the step of forming the assembly.

93. A method of completing a sub-sea well using a horizontal christmas tree for production flow control according to claim 92, wherein the step of forming the assembly further comprises the steps of landing and locking the tubing hanger in the body of the christmas tree.

94. A method of completing a sub-sea well using a horizontal christmas tree for production flow control according to claim 93, wherein the method further comprises the step of verifying the integrity of the completed assembly above the water line.

95. A method of completing a sub-sea well using a horizontal christmas tree for production flow control according to claim 94, wherein the step of verifying the integrity comprises the step of verifying hydraulic and electrical interfaces between the tubing hanger and the body of the christmas tree.

96. A method of completing a sub-sea well using a horizontal christmas tree for production flow control according to claim 94, wherein the step of verifying the integrity further comprises the step of verifying the pressure integrity of the assembly.

97. A method of completing a sub-sea well using a horizontal christmas tree for production flow control according to claim 92, wherein the step of running the assembly to the well head comprises the step of using a  
5 lower-riser package.